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TRANSACTIONS
OF
American Microscopical Society
(Published in Quarterly Instalments)

Vol. XL APRIL, 1921 No. 2

LARVAL FLUKES FROM GEORGIA[1]

(With two Plates)

By
Ernest Carroll Faust
Parasitologist, Union Medical College, Peking

In a previous study (Faust 1919) I have reviewed the cercariae described from the United States. I discussed the regions from which forms had been reported and suggested that the Southeastern United States offered an unexplored field where conditions were eminently favorable for their existence.

From October 1918 to May 1919 I had the opportunity to examine several hundred mollusks from the region of Rome, Georgia, and in two of these species, *Goniobasis carinifera* Lamarck and *Anculosa carinata* Brug, I have discovered the larval flukes described in this paper. I wish to acknowledge my indebtedness to Mrs. Lola Swift Faust for the collection of the material and to Mr. Bryant Walker for the determination of the hosts.

The larvae represented in this investigation are all distomes and fall into the following groups:

Allocreadiine larvae	1
xiphidiocercariae	3
microcercous cercaria	1
echinostome larva	1
furcocercariae	2
cystocercous cercaria	1

All of these forms are new to this region. Two have been described in a previous paper (Faust 1919a).

Cercaria thalia nov. spec.

(Figs. 1, 2)

Host: *Goniobasis carinifera* Lamarck.

This interesting larva for which I propose the name *Cercaria thalia* was found in *Goniobasis carinifera* Lamarck, collected from Rotary Lake,

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[1] Contributions from the Department of Pathology, Union Medical College, Peking, China.

Rome, Georgia. The redia and cercaria stages were dissected out of the digestive gland of the snail, while the agamodistomes were found in the lung sac. Both the redia and the cercaria were characterized by a graceful movement.

In the cercaria a good share of the organs are rendered opalescent by the sub-integumentary cells which are muciferous rather than cystogenous in structure. The larva is distinguished by a pair of eye-spots just lateral to the pharynx. The body measures 0.4 mm. in length by 0.15 mm. in width. The tail is slightly longer and has a proximal diameter of 57μ. The oral sucker measures 71μ in section while the acetabulum when extended has a diameter of 90μ. No spines have been observed on the body or tail. There is a prepharynx and a small pharynx with a short esophagus showing constrictions at intervals along its course. The ceca terminate about one-third the body distance from the posterior end. There are three pairs of mucin glands, with ducts opening on the dorsal aspect of the orifice.

The excretory bladder has a long median shank and slender cornua so that the entire appearance is that of a furculum with a supporting stem. I have observed a triplet group of flame cells at the anterior extremity of the body and a similar number at the posterior limit, but have been unable to make out the number of groups intermediate. From the group formula which I have previously shown to exist for this family of trematodes (Faust 1919a:334) four other flame cell units are to be expected. A median collecting tubule runs almost the entire distance of the tail.

The agamodistome (Fig. 2) lacks the pigmented eyespots and, indeed, shows few of the larval characters. The most readily recognizable common feature is the excretory bladder. On the other hand this fluke shows evidences of rapid maturity. The shape is that of a mature worm rather than that of a larva. The ceca have enlarged and what is especially noteworthy, the genital organs have reached a high degree of complexity. The testes and ovary are in their relative positions, the vitelline follicles are well formed, the seminal vesicle and the seminal eceptacle are each conspicuous and Laurer's canal is distinguishable So well developed are all of these organs that it is a simple matter to place the worm in the Allocreadiinae. Thus a considerable share of the life history of this animal is at hand, even tho only the first larval host is known.

The cercaria is produced in a redia with a small orange-colored gut, a short prepharyngeal region, a small pharynx, and a small but conspicuous birth pore. Moreover, both daughter rediae and cercariae develop within the same parent redia. It is noteworthy that the cercaria possesses eyespots, a common feature of the larval allocreadid form, but lacks a stylet.

Cercaria camilla nov. spec.

(Fig. 3)

Host: *Goniobasis carinifera* Lamarck.

The stylet cercaria for which I propose the name *Cercaria camilla* is a rapidly moving larva with an oblong-ovate body 0.16 mm. long by 0.066 mm. wide and a tail 0.11 mm. long and 18μ in diameter at the base. Both body and tail are spinose. The oral sucker is 26μ in diameter while the acetabulum measures only 13μ in transection. The latter lies midway between the anterior and posterior limits of the body.

Inserted into the roof of the anterior end is a typical quilled stylet. The oral sucker leads into an enormous prepharyngeal pocket 53μ in diameter, with a thick, semi-muscular, semi-mucoid wall. This in turn leads directly into a minute muscular pharynx. Beyond the pharynx a short esophagus connects with a part of short blunt ceca. The mucin glands consist of three pairs. Two of these pairs are granular, acidophilic, while one pair is densely muciferous, basophilic in reaction. The contents of each gland passes thru a long duct to empty at the side of the stylet.

The excretory bladder has the shape of an inverted truncated pyramid, from which emerge delicate collecting tubules. These tubules when traced to their sources reveal on each side of the body four pairs of flame cells posteriorly disposed. A single collecting tubule runs down the middle part of the tail. The flame-cell formula has an identical common denominator with that of *Allocreadium isoporum* Looss (Faust 1919a:327, 334), namely

$$(2 \quad 2+2+2) \quad (2+2)$$

The parthenita of *C. camilla* is a very simple sac-shaped sporocyst containing eight to twelve cercariae. Encystment of the cercariae has not been observed.

Cercaria tabitha nov. spec.

(Fig. 4)

Host: *Goniobasis carinifera* Lamarck.

This cercaria for which I suggest the name *Cercaria tabitha* has an ovoid body 0.15 mm. long by 0.088 mm. wide and a blunt tail 0.1 mm. long by 0.017 mm. in diameter at the base. The body is covered with heavy spines and the oral sucker is provided with a blunt stylet. The large oral sucker, 32μ in diameter, is provided internally with a thick mucoid substance resembling that of the stylet. Behind this is a small pharynx. There are four mucin glands on each side of the body, one of which contains a basophilic substance. They all empty far laterad at the margin of the oral sucker. The remainder of the digestive tract has not been traced. The acetabulum is in the middle of the ventral side of the body. It measures 21μ in diameter.

The excretory bladder is cup-shaped. The collecting tubules emerge from the anterolateral aspect of the bladder while the pore is posteriad.

The sporocyst is a simple, sacculate structure, containing up to twenty-four larvae.

The tail of the cercaria is dropped readily under a cover glass, but encystment has not been observed.

Cercaria pandora nov. spec.

(Fig. 8)

Host: *Goniobasis carinifera* Lamarck.

This little larva for which I suggest the name *Cercaria pandora* is oblong-ovate with a body measurement of 0.145 mm. in length by 0.054 mm. in width and a tail not more than half as long by 17μ in diameter at the base. The anterior sucker is large, measuring 38μ in diameter. The acetabulum is mesad and very small (14μ). A small stylet with a sharp, delicate point is inserted into the dorsal wall of the oral sucker. A small pharynx is located just behind the orifice. It leads into a forked gut densely surrounded with gland cells. The mucin glands consist of four pairs, the posterior one of which has a large nucleus and gives an acidophilic reaction.

The excretory bladder is a roughly truncated cone with conspicuous lateral cornua. The caudal excretory canal has several tributaries but no observable flame cells.

The larva develops in large numbers in simple sacculate sporocysts.

Cercaria medea nov. spec.

(Fig. 7)

Host: *Goniobasis carinifera* Lamarck.

This larval fluke for which I suggest the name *Cercaria medea* has a long, slender body and a short, stubby tail. The latter is so limited in extent as to place the larva in the group of the microcercous cercariae.

The animal measures 0.22 mm. in length by 0.065 mm. in width and has a tail only 21μ long. The latter structure in semiglandular, the products of which are poured into a common atrium. The cells are chromophobic and have irregular shaped nuclei. The anteriormost part of the body together with the acetabulum bear small sharp spines. The oral sucker has a diameter of 25μ and the acetabulum of 27μ. Inserted in the dorsal wall of the oral sucker is a minute, simple-pointed stylet (See fig. 7a).

Behind the oral sucker is a small pharynx. A long, narrow esophagus runs back from this to the anterior aspect of the acetabulum, whence the ceca continue posteriad to the subcaudal region of the body. A group of twelve to fifteen mucin glands is situated on each side of the body posterior to the acetabulum. A very delicate bundle of ducts conveys the products of these glands to the region of the stylet.

The excretory bladder is long and bag-shaped, giving rise to a pair of cornua laterad just behind the acetabulum. The main collecting tubule on each side of the body bifurcates just anteriad to the acetabulum. A median tubule extends into the tail and opens into the mucin pocket.

Two strings of germ cells extend longitudinally across the acetabulum.

The sporocyst in which the cercariae develop varies greatly in size. It has a muscular anterior end and at irregular intervals has constrictions. The movement of both the cercaria and the sporocyst is slow.

Cercaria penthesilia nov. spec.

(Fig. 9)

Host: *Goniobasis carinifera* Lamarck.

This cercaria for which I propose the name *Cercaria penthesilia* is an echinostome larva which is probably immature, in which the circlet of collar spines has not yet developed. It measures 0.2 mm. in length by 0.084 mm. in width, and has a tail 0.135 mm. long by 14μ in diameter at the base. The body is covered with many short spines closely studded together. The oral sucker has a diameter of 30μ and the acetabulum of 32μ. The entire body has a thick subintegumentary lining of long rhabditiform cystogenous granules, which bear evidence of the animal's future encystment. A fluted keel is found in the distal third of the tail.

There is a short prepharyngeal region of the digestive tube followed by a small pharynx. The esophagus forks almost immediately to form ceca which extend far caudad. Paired groups of acidophilic mucin glands run mesad to the ceca.

The excretory bladder is spheroidal with a large opening dorsocaudad. The cornu on each side is quite inconspicuous. From it a dilated collecting tube is traced which becomes narrow in the region of the pharynx. Several flame cells have been found but the exact number has not been worked out. Running posteriad from the bladder is a collecting tube for the tail. Halfway down the tail it divides to form a pair of tubules opening laterad.

The genital system is represented by two groups of germ cells lying longitudinally across the acetabulum. The nervous system is conspicuous, with especially large ventral trunks.

The redia in which the cercaria develops is provided with the pharynx, gut, birthpore and lateral appendages found in the echinostome group.

Cercaria quattuor-solenata Faust 1919
and
Cercaria furcicauda Faust 1919

(Figs. 5, 10)

These furcicaudous species, *Cercaria quattuor-solenata*, and *C. furcicauda*, were originally described in connection with a study of the excretory system of distome cercariae (Faust 1919a: 337, 338) and are included here for the sake of completeness. The host of both species is *Anculosa carinata* Brug.

Cercaria stephanocauda nov. spec.

(Fig. 6)

This interesting larva which I have designated as *Cercaria stephanocauda* represents a group which has recently received considerable attention (Ward 1916, Pratt 1919, Faust 1918). Five species have been described from North America. While in many respects the structure of the body of the immature larva resembles that of the described species, the tail is unique.

The worm has a body 2 mm. long and 1.2 mm. wide. The shank of the tail is 4 mm. long, while the lamellate furcae measure 1.1 mm. long and 0.5 mm. wide. The anterior fourth of the tail shank consists of a collared region with about nine definite ringed constrictions, running around the tail. At the posterior end of this collar there are numerous tubercules in a single row which are the only traces of mammilations anywhere on the body. Behind this collar the tail proceeds toward the distal portion with gradual constriction. The tail is attached to the body proximally by a number of powerful longitudinal muscles.

The oral sucker measures 430μ in diameter and the smaller ventral sucker, 360μ. The pharynx just behind the oral sucker has a diameter of 200μ. It connects with the ceca by a very short esophagus. The ceca proceed directly laterad almost to the posterior margin of the body. They are slightly convoluted.

The excretory system consists of a minute bladder and large collecting tubules. The latter reach to the region of the oral sucker, then are reflexed and break up into capillaries. A large collecting tubule extends the length of the tail, forking into the furcae and opening outward at the distal end of each furca.

The genital glands are very immature as contrasted with the condition in *Cercaria macrostoma* (Faust 1918). The germ glands are connected by a chain of cells which lie in the median line, with one gland offside to the left.

The sporocyst is large, being a simple sac with undifferentiated tissue.

Summary

A study of cercariae taken from snails at Rome, Georgia, shows new species with interesting relations to previously described forms.

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DESCRIPTION OF PLATES

Figs. 1, 2.—*Cercaria thalia* 1, cercaria, ventral view, X 126; 2, agamodistome, ventral view, showing precocious development of genital organs, X 40.

Fig. 3.—*Cercaria camilla*, ventral view, X 400.

Fig. 4.—*Cercaria tabitha*, ventral view, X 285.

Fig. 5.—*Cercaria quattuor-solenata*, ventral view, X 200.

Fig. 6.—*Cercaria stephanocauda*, ventral view, X 28.

Fig. 7.—*Cercaria medea*, ventral view, X 90; 7a, detail of stylet.

Fig. 8.—*Cercaria pandora*, ventral view, X 285.

Fig. 9.—*Cercaria penthesilia*, ventral view, X 276.

Fig. 10.—*Cercaria furcicauda*, ventral view, X 200.

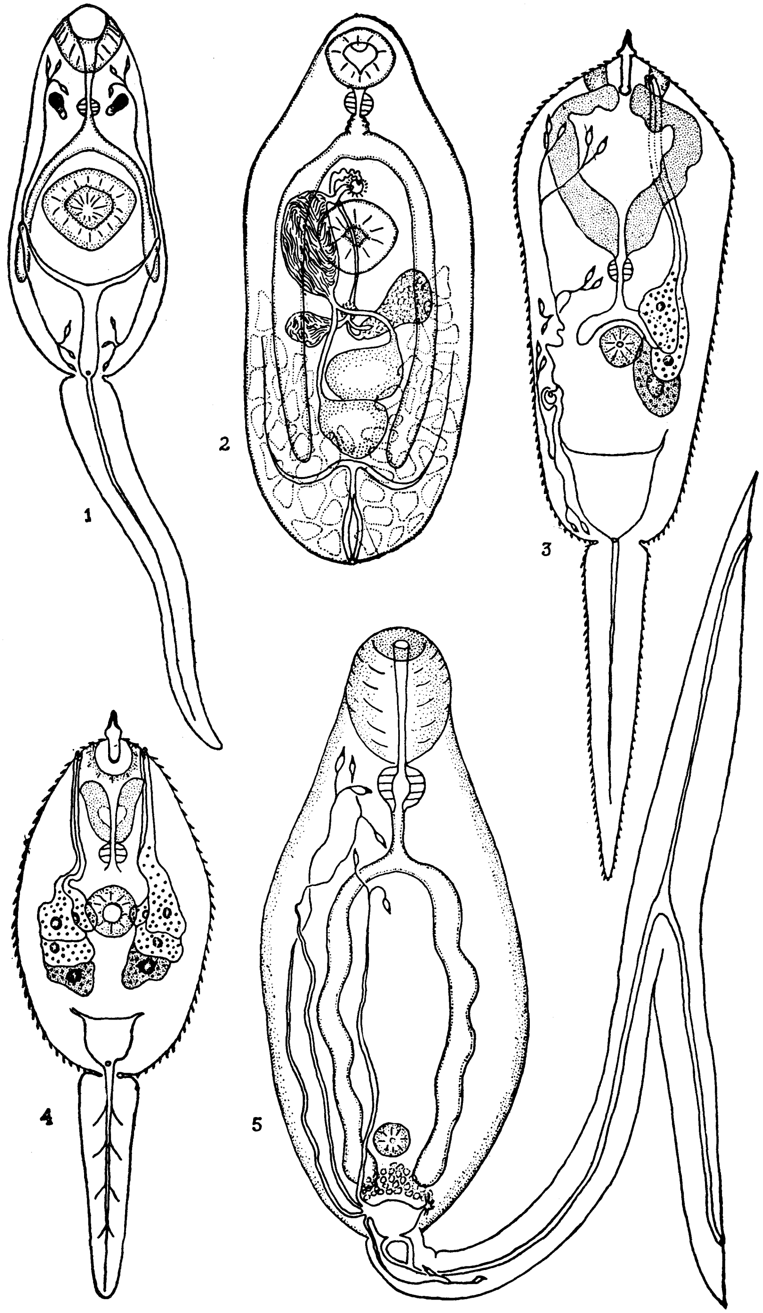
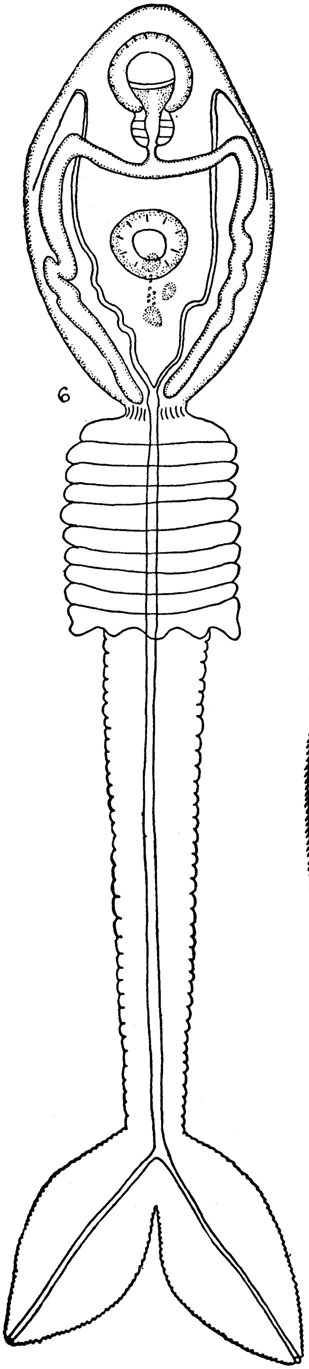


PLATE II.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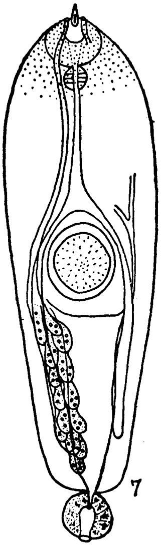
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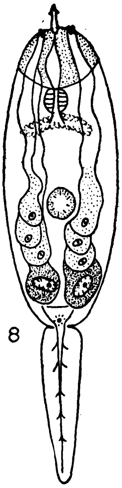
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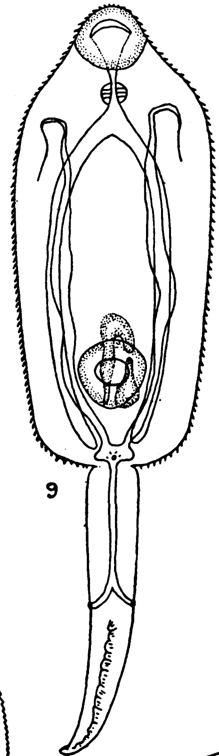
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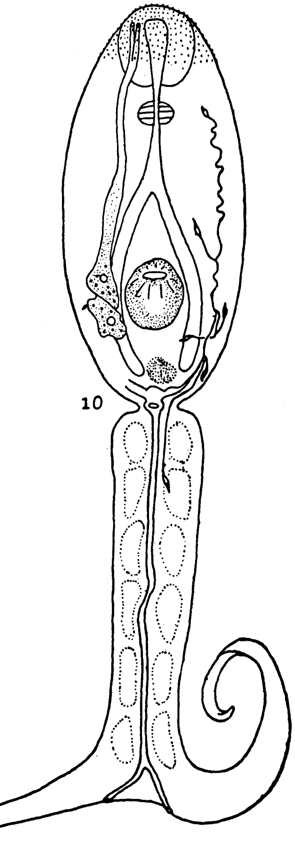
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PLATE III.